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Book Review

Introducing Behavioral Pharmacology: A Review of Primers by Poling and by Carlton

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Drug use is so entrenched in our society that anyone interested in human behavior must consider its influence. For example, caffeine is ingested daily by approximately 217 million people in the United States (Gilbert, 1984). Additionally, as of 1985, 113 million people in the United States reported current use (i.e., at least once in the past 30 days) of alcohol, 60 million people reported current use of cigarettes, 18 million people reported current use of marijuana, and 5.8 million people reported current use of cocaine (Kozel & Adams, 1986; National Institute on Drug Abuse, in press). Along with such high levels of nonmedical drug use, various antianxiety, antidepressant, antipsychotic, anticonvulsant, and analgesic drugs are regularly prescribed in our society (National Prescription Audit, 1986). Thus, most of the people we encounter are likely to be under the influence of one or more drugs.

Behavioral pharmacology, a discipline based on the principles of behavior analysis and traditional pharmacology, provides a scientific foundation for understanding the behavioral effects of drugs. Since the mid-1950s, this discipline has made important contributions not only to understanding behavioral drug action, but also to elucidating basic behavioral principles and theory. For example, behavioral pharmacology research has underscored the fundamental importance of schedules of reinforcement (Dews & DeWeese, 1977; McKearney & Barrett, 1978), has provided important empirical demonstrations of how historical and current contextual variables exert control over ongoing operant behavior (Barrett, 1986; Barrett & Witkin, 1986) and has illustrated how interoceptive stimuli (drug effects) can exert precise and quantifiable discriminative control over operant behavior (Bickel et al., 1987; Overton, 1984). In our opinion, some of the strongest empirical support for a contextualistic worldview in the experimental analysis of behavior can be found in behavioral pharmacology. Behavioral pharmacology research also has contributed to applied behavior analysis. For example, contributions have been made in the treatment of drug abuse (see Grabowski, Stitzer, & Henningfield, 1984) and in screening for behavioral toxicity in the developmentally disabled and other patient populations undergoing drug therapy (see Krasnegor, Gray, & Thompson, 1986).

In this paper, we review two currently available primers that should be helpful in introducing students and professionals to behavioral pharmacology: *A Primer of Human Behavioral Pharmacology* by A. Poling (1986) and *A Primer of Behavioral Pharmacology: Concepts and Principles in the Behavior Analysis of Drug Action* by P. L. Carlton (1983).

A Primer of Human Behavioral Pharmacology by A. Poling is available from Plenum Press, New York. *A Primer of Behavioral Pharmacology: Concepts and Principles in the Behavioral Analysis of Drug Action* by P. L. Carlton is available from W. H. Freeman and Company, New York. Preparation of this manuscript was supported in part by USPHS Research Grant DA04545-01 (S. T. Higgins) and Research Scientist Development Award DA-04066 (J. R. Hughes). Correspondence and reprint requests should be sent to: Stephen T. Higgins, University of Vermont, Department of Psychiatry, One South Prospect Street, Burlington, Vermont 05401.

POLING'S PRIMER

Poling's primer is 246 pages in length and is divided into eight chapters along with an extensive reference list (331 references) and index. Chapter 1 outlines the historical origins of behavioral pharmacology with the following four factors being identified as major contributors to the growth of this discipline: (1) the growth and refinement of methods in the experimental analysis of behavior; (2) the discovery of the antipsychotic drug chlorpromazine and the subsequent interest within psychiatry and pharmaceutical companies in pharmacotherapies for psychiatric disorders; (3) the rise in drug abuse in the United States; and (4) increasing interest in the behavioral effects of environmental toxins.

Chapters 2 and 3 overview the basic principles of pharmacology and behavior analysis, respectively. Chapter 2 covers drug classification, pharmacokinetics, tolerance, physical dependence, and receptor theory. Chapter 3 carefully outlines historical events in the history of behavior analysis, as well as assumptions basic to this approach. Poling provides a succinct and insightful discussion of the description of functional relations as scientific explanation, which is summed up in the following statement:

> The notion that the description of functional relations provides an adequate explanation of behavior, or any other phenomenon, may not be intuitively obvious. However, in behavioral psychology as in science in general, it is held that something is "explained" when we can specify the events that "cause" it. (p. 63)

Chapter 3 also provides an understandable overview of the basics of respondent and operant conditioning. The discussion on behavioral principles, however, may be a bit too technical for the novice at times, especially the discussion of differentiation schedules.

Chapter 4 introduces the concept of drugs as functional stimuli, a fundamental component of behavioral pharmacology. Poling describes how drugs can enter into functional relations as unconditioned and conditioned stimuli in respondent operations and as discriminative, reinforcing, and aversive stimuli in operant operations.

Chapter 5 overviews, too briefly in our opinion, environmental determinants of the behavioral effects of drugs. Drug effects on learning, stimulus control, rate dependency, and the influence of the nature of the maintaining event on the behavioral effects of drugs are discussed. In Chapter 6, a transition is made to the use of behavioral pharmacology in clinical drug assessment. This chapter briefly reviews some of the steps involved in developing new therapeutic pharmacological agents and some shortcomings in psychiatric diagnosis, but primarily underscores the important contributions that could be gleaned from using sound experimental designs, operational definitions, and objective measurement in assessing the behavioral effects of drugs in clinical settings.

Drug abuse is discussed in Chapter 7, which is the domain where behavioral pharmacology has had its largest influence. Operant and respondent models of drug use and relapse are discussed. This chapter includes some particularly insightful examples of how drug dependence may develop in everyday situations. At times, however, the author's discussion of the role of rule-governed behavior in drug abuse seems unparsimonious.

Behavior analysts often bemoan the lack of impact of the behavioral approach to understanding and treating behavioral disorders. The influence of behavioral pharmacologists in the field of drug abuse, however, seems to be a notable exception. The recent appointment of Dr. C. R. Schuster, a prominent behavior analyst, as Director of the National Institute on Drug Abuse (NIDA) and the existence of a funding division within this agency largely dedicated to behavioral pharmacology research provides a clear example of the impact of behavioral pharmacology on research in drug abuse. A behavior analyst in such a prestigious and influential position is an accomplishment of both the individual and the behavioral

approach, and neither should go unrecognized. To our knowledge, Schuster's appointment is one of the best examples of the ability of behavior analysts to enter a field, to do good science, and ultimately to have an impact on our culture.

Chapter 8 is the final chapter in the text and outlines the author's views on the future of behavioral pharmacology. Poling argues that behavioral pharmacology needs to make larger inroads into clinical drug treatments, toxicology, and understanding complex human behavior. We concur. Additionally, Poling argues that behavioral pharmacology must remain a viable and independent discipline as opposed to becoming "a handmaiden to the neurosciences" (p. 212). In this regard, he comments on the shortcomings of reductionism and identifies drug-discrimination and receptor-theory research as examples of areas that are taking many behavioral pharmacologists in the "handmaiden," reductionistic direction.

We generally concur on these matters as well, although we are probably less alarmed than Poling, especially with regard to drug-discrimination work. For those interested in interdisciplinary behavioral research, especially physiological correlates of behavior, for example, the high degree of concordance between drug-discrimination and in-vitro drug-binding research is very exciting. Behavior analysts have developed methods that allow neuroscientists to ask and, more importantly, answer questions not previously possible. In our opinion, providing such methodological inroads to other disciplines interested in behavior should, in the long run, only be a feather in the behavior analyst's cap. But let us not be misinterpreted: We too oppose reductionistic and nonbehavioral explanations of behavioral phenomena. However, we do not feel that demonstrating concordance between behavioral and physiological events or acknowledging receptor theory *need necessarily* lead to reductionistic explanation or detract from behavior as a legitimate scientific subject matter. In our opinion, behavior analysts should be among the best suited for teasing apart environment-behavior-physiological relations in a nonreductionistic manner. Research by Dworkin and his colleagues (see Dworkin & Smith, in press), for example, is exemplary in demonstrating how behavioral and physiological measures can be effectively included in behavioral pharmacology research without resorting to reductionism.

CARLTON'S PRIMER

Carlton's primer is 301 pages in length. The text is divided into an introduction (Chapter 1) and the following seven sections: (1) the measurement of drug effect (Chapters 2–4), (2) drugs as stimuli (Chapters 5–7), (3) the phenomenon of tolerance (Chapters 8 & 9), (4) diversity and classification (Chapters 10 & 11), (5) models of clinical drug response (Chapters 12–14), (6) the analysis of models (Chapters 15–18), and (7) a reference section (176 references) and an index. All sections but the last also contain brief introductions.

Chapter 1 outlines in general terms the topics to be covered in the text and includes a brief history of behavioral pharmacology. Carlton mentions the increased funding of research on the behavioral effects of drugs following the discovery of chlorpromazine and the refinement of the methods of the experimental analysis of behavior as key factors in the genesis of behavioral pharmacology.

The contextualistic tone evident throughout this text is set in the introduction to Section 1:

> We cannot think of the behavioral changes induced by drugs in terms of simple input-output relationships ("drug in–behavior out"); rather, we must think of these changes as occurring within a complex system of which drug action is only one part. (p. 6)

The basics of behavior analysis and pharmacology are covered in Section 1 (Chapters 2 & 3, respectively). The principles of behavior analysis are introduced via a review of various experimental procedures used in basic behavioral phar-

macology research (e.g., discriminated avoidance, nondiscriminated avoidance, conditional or "go no-go" avoidance, punishment, conditioned suppression, and simple and multiple schedules of reinforcement). Helpful schematic descriptions are included for most of these procedures. In outlining the basics of pharmacology, Carlton does an especially thorough job in describing dose-response functions and conveying the fundamental necessity of including multiple doses in drug studies. Numerous and compelling examples are used to outline the gross errors that may be encountered when only a single drug dose is studied. The author returns to this matter many times throughout the remainder of the text, which is only appropriate as this is a point that cannot be overemphasized. Receptor theory is also covered using an easy-to-understand and effective schematic to describe agonistic, partial agonistic, and antagonistic drug effects. Section 1 concludes with a careful discussion of rate dependency (Chapter 4).

The stimulus function of drugs (reinforcing, aversive, and discriminative) is adequately introduced in Section 2 (Chapters 5, 6 and 7). In discussing these functions, Carlton is careful not to attribute immutable "properties" to the drug, as is illustrated in the following statement:

> The stimulus properties of a drug obviously do not inhere solely in the drug itself. Rather, it is clear that a drug may be either reinforcing or aversive as a consequence of the multiplicity of variables that can interact to determine behavioral outcome. The resultant question, then, is not whether a drug is or is not reinforcing or aversive—as if these were mutually exclusive possibilities—but in which circumstances a given drug is one or the other. (p. 98)

Similar to the admonition against studying only a single drug dose, the point that drug effects are not immutable properties of the molecule is one that cannot be overemphasized. In many ways, the importance of multiple doses and the mutability of drug effects seem quite straightforward, yet even a casual perusal of the literature reveals how often they are ignored in common practice. Returning to the principles of behavior, some behavior analysts are likely to take issue with a couple of matters in Section 2, such as Carlton's implicit acceptance of the construct of memory (pp. 109–110) and perhaps his use of the word "cue" to describe discriminative functions.

The discussion of drug tolerance in Section 3 (Chapters 8 & 9) is excellent, especially with regard to the influence of environmental factors. Typically, physical dependence and withdrawal are discussed in close proximity to drug tolerance, but that is not the case in this text; in fact, dependence and withdrawal are not covered anywhere—a surprising omission.

Section 4 on diversity and classification deals with the well known difficulties related to the classification of behaviorally active drugs. The strengths and shortcomings of various classification schemes are discussed. This section provides a nice lead into Sections 5 and 6 on laboratory models of clinical drug response. Those familiar with behavioral pharmacology are likely to be surprised by the amount of space devoted to formal model building; in our experience, formal models, as such, are uncommon in behavioral pharmacology. Nevertheless, Carlton does an excellent job outlining the necessary ingredients for an adequate laboratory model of a clinical syndrome and in so doing also provides the reader with a sophisticated but comprehensible discussion of the behavioral pharmacology of antianxiety, antipsychotic, and antidepressant drugs. Many believe that the function of any scientific discipline is to simplify, that is, to define a few basic principles that explain many phenomena. Contextualism would seem to make one's view of the world more complex rather than simple. Carlton directly attacks this apparent paradox by using both logical and empirical criteria to show how a classification scheme of drugs is possible within a contextualistic model.

CONCLUDING COMMENTS

Introductory primers can have at least three goals. (1) They can interest readers in the area; (2) they can introduce the

theoretical assumptions and paradigms of a discipline; and (3) they can teach the empirical principles that have been established. As can be gleaned from our comments above, these two primers do well on all three points. Interestingly, Poling's text is entitled "A Primer in Human Behavioral Pharmacology," yet much nonhuman work is cited; in contrast, Carlton's text does not include the word human in its title, yet his discussion of laboratory models for assessing the effects of antianxiety, antipsychotic, and antidepressant agents is likely to be of interest to those with a clinical orientation. Both texts include many clinical examples, both cover metatheoretical assumptions common to behavioral pharmacology (e.g., contextualism), and both texts introduce the reader to the important empirical findings of behavioral pharmacology (e.g., rate dependency, stimulus function of drugs). Instructors will have to choose for themselves which of these two texts best meets their particular pedagogical needs. In our opinion, both texts do a sound job of introducing the unfamiliar to behavioral pharmacology.

REFERENCES

Barrett, J. E. (1986). Behavioral history: Residual influences on subsequent behavior and drug effects. In N. A. Krasnegor, D. B. Gray, & T. Thompson (Eds.), *Developmental behavioral pharmacology* (Vol. 5, pp. 99–114). Hillsdale, NJ: Erlbaum.

Barrett, J. E., & Witkin, J. M. (1986). The role of behavioral and pharmacological history in determining the effects of abused drugs. In S. R. Goldberg & I. P. Stolerman (Eds.), *Behavioral analysis of drug dependence* (pp. 195–223). Orlando, FL: Academic Press.

Bickel, W. K., Mathis, D., Emmet-Oglesby, M., Harris, C., Lal, H., Gauvin, D. V., Young, A. M., Schindler, C., Weiss, S., & Williams, B. A. (1987). Stimulus control: Continuity or discontinuity? Views from the study of interoceptive and exteroceptive stimuli. *The Psychological Record, 37,* 153–198.

Carlton, P. L. (1983). *A primer of behavioral pharmacology: Concepts and principles in the behavioral analysis of drug action.* New York: W. H. Freeman.

Dews, P. B., & DeWeese, J. (1977). Schedules of reinforcement. In L. L. Iversen, S. D. Iversen, & S. H. Snyder (Eds.), *Handbook of psychopharmacology—principles of behavioral pharmacology* (Vol. 7, pp. 107–150). New York: Plenum.

Dworkin, D. I., & Smith, J. E. (in press). The assessment of neurochemical correlates of operant behavior. In A. A. Boulton, G. B. Baker, & A. J. Greenshaw (Eds.), *Neuromethods: Psychopharmacology I* (Vol. 13). Clifton, NJ: Humana.

Gilbert, R. M. (1984). Caffeine consumption. In G. A. Spiller (Ed.), *The methylxanthine beverages and foods: Chemistry, consumption, and health effects* (pp. 185–213). New York: Alan R. Liss.

Grabowski, J., Stitzer, M. L., & Henningfield, J. E. (1984). *Behavioral intervention techniques in drug abuse treatment. NIDA Research Monograph, 46.* Washington, DC: U.S. Government Printing Office.

Kozel, N. J., & Adams, E. H. (1986). Epidemiology of drug abuse: An overview. *Science, 234,* 970–974.

Krasnegor, N. A., Gray, D. B., & Thompson, T. (1986). *Developmental behavioral pharmacology* (Vol. 5, pp. 99–114). Hillsdale, NJ: Erlbaum.

McKearney, J. W., & Barrett, J. E. (1978). Schedule-controlled behavior and the effects of drugs. In D. E. Blackman & D. J. Sanger (Eds.), *Contemporary research in behavioral pharmacology* (pp. 1–64). New York: Plenum.

National Institute on Drug Abuse (in press), *National survey on drug abuse: Main findings: 1985,* Department of Health and Human Services, U.S. Government Printing Office.

National Prescription Audit (1986). Ambler, PA: IMS America Ltd.

Overton, D. A. (1984). State dependent learning and drug discrimination. In L. L. Iversen, S. D. Iversen, & S. H. Snyder (Eds.), *Handbook of psychopharmacology* (pp. 59–127). New York: Plenum.

Poling, A. (1986). *A primer of human behavioral pharmacology.* New York: Plenum.